



Australian Government
Department of Defence
Defence Science and
Technology Organisation

Automatic Identification System: AIS-A Reception of AIS-B, 2008 Study

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DSTO-TN-0867

ABSTRACT

The use of the Automatic Identification System (AIS) has been mandated for ships over 300 gross tonne since December 2004. Through Border Protection Command, DSTO was tasked to assist the Australian Maritime Safety Authority with the assessment of the performance of AIS and a new variant AIS-B. AIS-B is a cut down version meant for smaller vessels but there have been concerns by the maritime community that AIS-B cannot be detected sufficiently by vessels carrying AIS. This report covers a three month study investigating this issue. The outcome, based on a survey of vessels entering Newcastle Port, was that the different AIS fitouts carried were capable of detecting AIS-B signals. However, 17% of these vessels did not report detections. This was more likely to occur if the model of AIS equipment only displayed the vessel's identification number because it was not capable of decoding and displaying the name of the AIS-B vessel. This finding indicates the lack of detection issue is to some extent caused by Vessel Masters not recognising the detection on their AIS displays. It was also discovered that even where the name of the AIS-B vessel was displayed, the AIS displays do not distinguish between AIS and AIS-B detections.

RELEASE LIMITATION

Approved for public release

Published by

*Maritime Operations Division
DSTO Defence Science and Technology Organisation
PO Box 1500
Edinburgh South Australia 5111 Australia*

Telephone: (08) 8259 5555

Fax: (08) 8259 6567

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AR-014-358

December 2008

APPROVED FOR PUBLIC RELEASE

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Executive Summary

Border Protection Command, a joint Customs and Defence agency have requested the Defence Science and Technology Organisation (DSTO) assist the Australian Maritime Safety Authority (AMSA) in its work on the Automated Identification System (AIS). In Australia AMSA is involved in a coordinated whole-of-government approach to AIS issues and has been leading the on-going assessment of AIS performance. This report covers a DSTO study, requested by AMSA, investigating the reception of AIS-B signals by vessels carrying AIS-A.

Within AIS there is a new variant, AIS-B, which is intended for small vessels. Before widespread uptake of AIS-B occurs AMSA would like assurances that it will operate as intended. One of the issues raised in the maritime community is that some commercial vessels with AIS have been reported to have been unable to detect the AIS-B signals from smaller vessels. Accordingly, AMSA requested DSTO perform a study investigating the reception of AIS-B signals by ships carrying AIS, to determine the extent of the problem.

To this end DSTO performed a three month study, from 1 September 2008 until 28 November 2008, in Newcastle Port. DSTO placed an AIS-B transmitter at the mouth of Newcastle Port, on Nobby's Head Lighthouse, and commercial vessels entering port were surveyed. The survey collected information about the AIS equipment on board and whether an AIS-B signal was detected / displayed by this equipment.

The results from the study indicate that 94% of the AIS equipment carried by the vessels that entered Newcastle Port and completed a survey is capable of receiving and decoding AIS-B signals. No conclusion could be drawn on the remaining 6% of units because insufficient information was collected via the surveys.

Of the vessels carrying AIS equipment that the surveys showed were capable of receiving and decoding an AIS-B signal, 17% reported no AIS-B detections. The study results indicate this was more likely to occur when the AIS-A equipment was not capable of displaying the name of the AIS-B vessel, suggesting, in some of these cases, that the Vessel Master may not have recognised the detection.

A significant lesson learnt was that, even where the vessel names are displayed, it is important to specify particular AIS-B vessels when questioning a Vessel Master about AIS-B detections. This is because AIS-A displays do not distinguish AIS-A detections from AIS-B detections.

Contents

GLOSSARY

1. INTRODUCTION.....	1
2. AIS-B DESCRIPTION.....	1
3. STUDY SET UP	2
3.1 Study assumptions	2
3.2 Installation	3
3.2.1 Nobby's Head installation.....	3
3.2.2 ACMA approval to transmit.....	5
3.2.3 Notice to Mariners.....	5
3.2.4 Dredges carrying AIS-B.....	5
3.3 Collection of data.....	6
3.3.1 Survey forms	6
3.3.1.1 Survey Version 1.....	7
3.3.1.2 Survey Version 2.....	7
3.3.1.3 Distribution of surveys	7
3.3.2 Vessel movements	8
3.3.3 AMSA AIS data.....	8
3.3.4 AIS-B self reporting.....	8
4. STUDY RESULTS	8
4.1 Surveys.....	8
4.1.1 Results from surveys.....	8
4.2 AIS equipment on-board commercial vessels.....	9
4.2.1 AIS-A equipment types and capabilities.....	9
4.2.2 Standards satisfied	10
4.3 AIS-B detections.....	11
4.3.1 AIS-B detection – all ranges	11
4.3.2 AIS-B detection – within study range.....	12
4.4 Other interesting findings/observations	13
4.4.1 Display characteristics of Furuno FA-150.....	13
4.4.2 Vessel engagement with AIS Trial 1 unit.....	14
4.4.3 Performance of single installation of SeaTex AIS 100	14
5. CONCLUSIONS.....	14
6. ACKNOWLEDGEMENTS	15
7. REFERENCES	16

APPENDIX A: AIS MESSAGE REPORTING INTERVALS..... 19

APPENDIX B: AIS INSTALLATIONS..... 21

APPENDIX C: SURVEY FORM 1..... 23

APPENDIX D: SURVEY FORM 2..... 27

APPENDIX E: NEWCASTLE VESSEL AGENTS..... 31

APPENDIX F: AIS STANDARDS DOCUMENTS..... 33

Glossary

ACMA	Australian Communications and Media Authority
AIS	Automatic Identification System
AMS	Australian Maritime Systems
AMSA	Australian Maritime Safety Authority
AS	Australian Standard
AtoN	Aid to Navigation
BPC	Border Protection Command
CS	Carrier Sense, refers to CSTDMA
CSTDMA	Carrier Sense Time Division Multiple Access
DSTO	Defence Science and Technology Organisation
GPS	Global Positioning System
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IEC	International Electrotechnical Commission
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication Sector
IMO	International Maritime Organisation
JRC	Japan Radio Company
MMSI	Maritime Mobile Service Identity
MSC	Maritime Safety Committee (IMO)
SO	Self Organising, refers to SOTDMA
SOTDMA	Self Organising Time Division Multiple Access
SOLAS	Safety Of Life At Sea
TDMA	Time Division Multiple Access
VHF	Very High Frequency
VDL	VHF Data Link

1. Introduction

Border Protection Command (BPC), a joint Customs and Defence agency have requested the Defence Science and Technology Organisation (DSTO) assist the Australian Maritime Safety Authority (AMSA) in its work on the Automatic Identification System (AIS). In Australia AMSA is involved in a coordinated whole-of-government approach to AIS issues and has been leading the on-going assessment of AIS performance. This report covers a DSTO study, requested by AMSA, investigating the reception of AIS-B signals by vessels carrying AIS-A.

Since December 2004 [1] all international voyaging ships over 300 gross tonne have been mandated by the International Maritime Organisation (IMO) to carry and use AIS. AIS is a Very High Frequency (VHF) radio broadcast system that transfers ship position and identification information. Ships equipped with AIS are able to display the location of other AIS carrying ships on their radar screens or electronic chart displays. This improves their situational awareness assisting in collision avoidance. The AIS information is also collected by land based stations for use in search and rescue activities.

Within AIS there is a new variant, AIS-B, which is intended for small vessels. Before widespread uptake of AIS-B occurs AMSA would like assurances that it will operate as intended. One of the issues raised in the maritime community is that some commercial vessels with AIS have been reported to have been unable to detect the AIS-B signals from smaller vessels. Accordingly, AMSA requested DSTO perform a study investigating the reception of AIS-B signals by ships carrying AIS, to determine the extent of the problem.

To this end DSTO performed a three month study, from 1 September 2008 until 28 November 2008, in Newcastle Port. DSTO placed an AIS-B transmitter at the mouth of Newcastle Port, on Nobby's Head Lighthouse, and commercial vessels entering port were surveyed. The survey collected information about the AIS equipment on board and whether an AIS-B signal was detected / displayed by this equipment. This report covers the setup and results from the study.

2. AIS-B description

AIS (referred to AIS-A for clarity in this report) automatically transmits packets of data over the VHF. There are a number of message types used and the frequency of the transmission depends upon the message type and activity of the vessel (see Table A 1 in Appendix A for reporting intervals). Primarily the vessel's name, Maritime Mobile Service Identity (MMSI), location, speed, course and heading are transmitted. The shortest reporting interval is 2 seconds.

AIS-B is a variant of AIS-A and is intended for smaller vessels. There are two types of AIS-B equipment, differing from each other in network access method. Carrier-sense (CS) AIS-B equipment does not reserve transmission slots on the VHF Data Link (VDL) and

will not transmit in a slot used by AIS-A equipment. Self-organising (SO) AIS-B does reserve slots and behaves similarly to AIS-A in its access of the VDL. Like CS AIS-B, SO AIS-B uses a lower set of reporting rates. As the dominant variant of AIS-B in Australia is CS this is the only type of AIS-B examined by this study. All references to AIS-B in this report refer to the CS AIS-B variant unless otherwise stated.

Different standards apply to AIS-B equipment for a number of reasons, including ensuring the safety role of AIS-A is not compromised. When compared to AIS-A, AIS-B:

- is only able to transmit a reduced set of AIS message types;
- messages are sent less frequently (see Table A 2 in Appendix A: for CS AIS-B reporting intervals);
- uses a different network access method that is intended not to interfere with AIS-A transmissions.

AIS-B uses two message types for autonomous transmission, 18 and 24. Message 18 contains only a vessel's MMSI, location, course and heading. Message 24 is sent in two parts and contains the static vessel information such the vessel's name, length and beam. The shortest standard autonomous reporting interval is 30 seconds.

3. Study set up

3.1 Study assumptions

The aim of the study was to determine the reception of AIS-B by commercial vessels carrying AIS-A. However, engaging with every commercial ship in Australian waters was beyond the resources available for the study. Instead a sub-set of ships was engaged.

Ships entering Newcastle Port were selected as the sample set for two reasons. One: a review of ship movements indicated sufficient ships would enter Newcastle Port over a three month period to provide a statistically meaningful data set. Two: Newcastle Port was able to offer the support required to perform the study.

The reduced data set has led to the following assumption for the study:

1. The AIS-A equipment carried on commercial vessels entering Newcastle Port is a reasonable sample of what would be carried by ships operating in Australian waters.

3.2 Installation

3.2.1 Nobby's Head installation

With the approval of AMSA, on 28 August 2008, DSTO set up an AIS-B system on Nobby's Head Lighthouse, Newcastle (32° 55.1'S, 151° 47.9'E). Figure 1 shows the AIS Trial 1 unit location with respect to Newcastle Port docking locations.

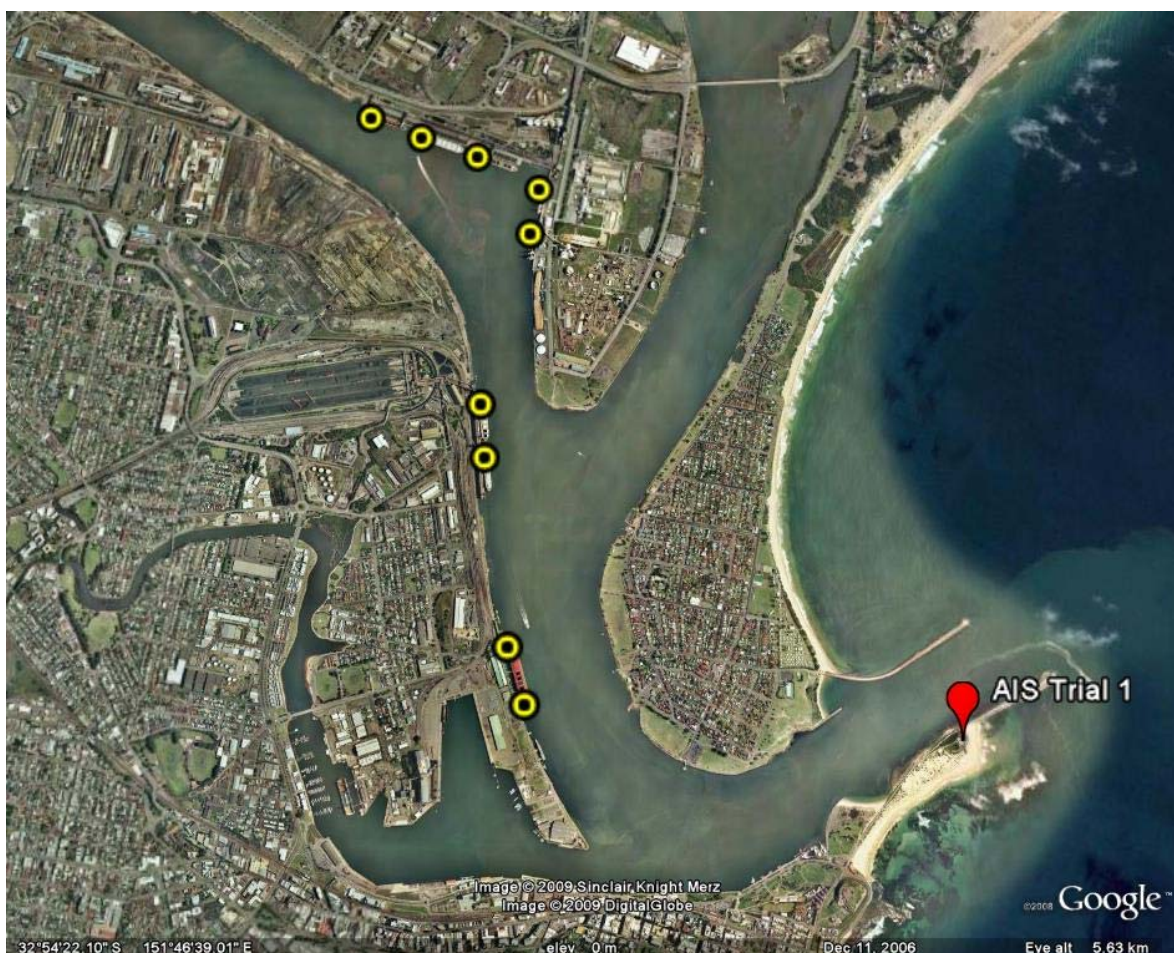


Figure 1: Newcastle Port. ● Represent ship docking locations. Image covers an area 3.78 n. miles by 2.86 n. miles

From 28 August 2008 until 10 September 2008 the system comprised:

1. Shine Micro AIS-B transponder (from here on called "AIS Trial 1")
2. NextG ([3G Universal Mobile Telecommunications System](#)) modem
3. Associated power supplies
4. 2.5m VHF 3dBi half wave whip antenna
5. Rojone MaxiNav Global Positioning System (GPS) antenna

Items 1 to 3 were located in a crate on the lower level of the light house. Items 4 and 5 were secured to a mast and fixed to the light shield on the southern exterior of the light house. Figure 2 shows the set up. For details of the AIS-B units, VHF antenna and GPS antenna see Appendix B.



Figure 2: AIS Trial 1 setup at Nobby's Head Lighthouse, showing the equipment crate (top left), the location of the crate on the lower floor (bottom left), and the positioning of the VHF and GPS antennae on the exterior (right).

The required cables were loosely fixed to the lighthouse to cater for works planned on the lighthouse balcony. Australian Maritime Systems (AMS) were the contractors managing this work and they kept DSTO informed of what works were occurring and when.

To check the reception in the different dock areas a DSTO team drove an AIS-A receiver around these areas monitoring the detection of the AIS Trial 1 unit. The standard rate of transmission of a stationary AIS-B unit is three minutes. A three minute interval between transmissions made testing very difficult and an inaccurate activity. To enable testing of the installation, from 10 September 2008 until the end of the study, 28 November 2008, item 1 was exchanged for an AMEC Comar AIS-B unit (still referred to as the AIS Trial 1 unit in this document). This unit could be software set for specific reporting intervals. Table 1 contains the AIS Trial 1 reporting intervals used during the study.

Table 1: The reporting intervals of AIS Trial 1, with respect to date

Date	Reporting Interval
1 Sept 08 - 10 Sept 08	3 minutes
10 Sept 08 - 30 Oct 08	2 seconds
30 Oct 08 - 28 Nov 08	3 minutes

On 30 October 2008 a loose connection to the VHF antenna was discovered and improved. Prior to this date the resulting reduced transmit power of AIS Trial 1 led to a transmit range of about 3.5 n. miles (as determined from the surveys received). Once the connection to the antenna was improved the transmit range increased to at least 10 n. miles. The maximum actual transmit range was not measured.

Testing of the installation was no longer required after 30 October 2008 so the reporting interval of the AIS Trial 1 unit was set back to the standard of three minutes. On 10 December 2008 all of the equipment was removed from the lighthouse.

3.2.2 ACMA approval to transmit

Approval to have the AIS Trial 1 unit transmitting from land was required from the Australian Communications and Media Authority (ACMA). ACMA's role is to ensure that the transmissions do not interfere with other existing transmissions in the area. This approval was arranged by AMSA and was obtained, in the form of a scientific license, in time for the commencement of the study.

3.2.3 Notice to Mariners

A notice to mariners was also required because AIS Trial 1 was on land, whereas AIS-B units are normally not shored based. Once again AMSA organised the notice to mariners. DSTO activated the notice when the unit was turned on and deactivated the notice when the unit was turned off.

3.2.4 Dredges carrying AIS-B

There were five dredges, managed by Boskalis Dredec JV, working in Newcastle River for the duration of the study. Each of these dredges carried a transmitting AIS-B unit.

Details on the AIS-B set up on two of the five dredges is contained in Appendix B. Information on the AIS-B set up on the remaining three dredges was not made available.

The dredges were invaluable as back-ups in the study and consequently four were explicitly named in version 2 of the survey form (see section 3.3.1 for a description of the survey forms). P.T. Kythira was not mentioned on the survey form because the study team were unaware of its presence until after V2 of the survey was distributed to Vessel Agents.

From the surveys it was noted that even when the AIS Trial 1 unit could not be detected because of a reduced transmit range, commercial vessels were able to detect the dredges. These dredges often went offshore, not far from the Newcastle Port entrance, to dump

spoil and were very useful when ships completed the survey whilst anchored offshore waiting to enter port. Figure 3 shows the indicative routes taken by the dredges.

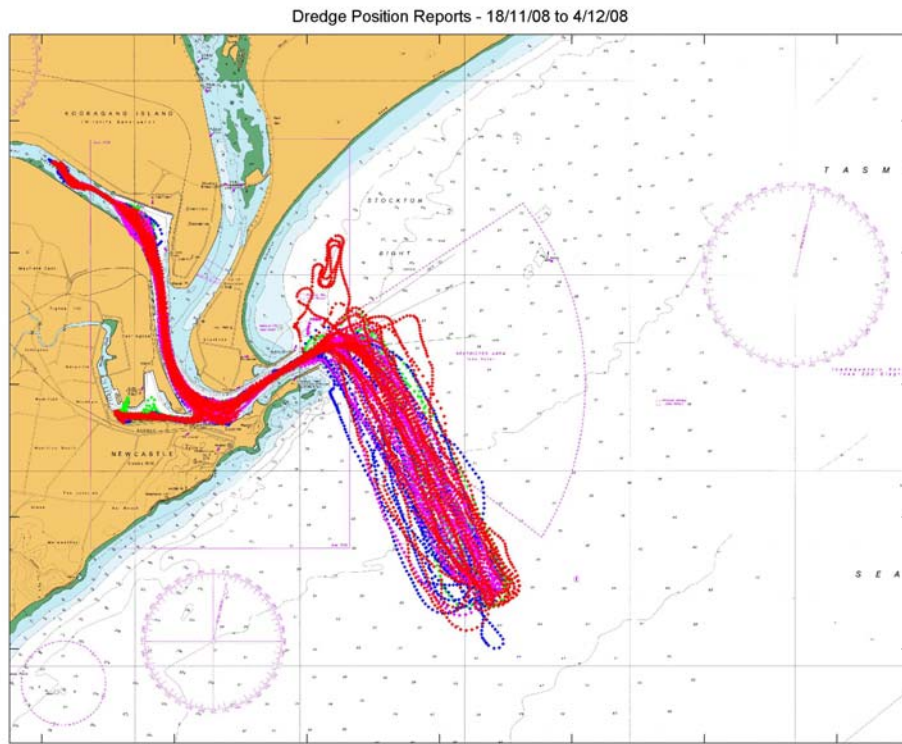


Figure 3: Indicative routes of dredges working in Newcastle Port during the study period

3.3 Collection of data

Four different forms of data were collected for the study:

1. the study survey,
2. the movement of ships into Newcastle port,
3. AIS Trial 1 signal as received by the nearby AMSA base station, and
4. the AIS Trial 1 activity as reported by the unit itself.

3.3.1 Survey forms

The primary study data was collected using a survey form. Vessel Masters were asked to complete the survey when within a specified distance from the AIS Trial 1 unit (location given as latitude and longitude, 32° 55.1'S, 151° 47.9'E). Two versions of the survey form were used in the study.

3.3.1.1 Survey Version 1

Version 1 (V1) of the survey form (Appendix C) asked Vessel Masters if they could detect the AIS Trial 1 unit and any other AIS-B unit. After a visit to two ships in dock DSTO discovered AIS-A displays do not flag detections as either AIS-A or AIS-B. Consequently there was no method for a Vessel Master to identify “other AIS-B detections”. This created confusion when they attempted to complete the survey. DSTO also discovered that detection of the AIS Trial 1 unit was blocked by infrastructure at some berth locations and the AIS Trial 1’s installation was causing a reduced transmit range.

3.3.1.2 Survey Version 2

To reduce these problems version 2 (V2) was created (Appendix D). The main changes were four of the Newcastle dredges carrying AIS-B were explicitly noted on the form and the range at which the survey was to be completed was reduced from 10 n. miles to 3.5 n. miles from the AIS Trial 1 unit.

Explicit naming of the dredges was added to remove the need for Vessel Masters to identify AIS-B vessels on their displays. Also, because the dredges were working near the dock area they were within line of sight to ships in dock. Consequently, when the AIS Trial 1 unit was not within line of sight because of infrastructure at least one of the dredges was, and so at all times at least one vessel carrying AIS-B was within line of sight to ships in dock.

The second change, the reduced range, was introduced because surveys were also being completed when ships were anchored offshore. Unfortunately the reduced transmit range of the AIS Trial 1 unit meant the signal was not detectable past approximately 3.5 n. miles.

On 17 September 2008 Vessel Agents were asked to distribute V2 instead of V1 of the survey form.

3.3.1.3 Distribution of surveys

The distribution and collection of the surveys was not undertaken directly by DSTO because DSTO did not have ready access to the commercial vessels entering Newcastle. Instead, this function was performed by the Newcastle Vessel Agents. There were a total of twelve companies approached for assistance with distributing and collecting in surveys. The list of Vessel Agent companies is given in Appendix E.

The Vessel Agents distributed the forms in the manner that suited their mode of operation. Distribution methods used were: by hand, email and fax. The ships returned the completed surveys to the Vessel Agents who then returned them, by email or fax, to DSTO.

3.3.2 Vessel movements

The number of ships entering Newcastle Port was obtained from Newcastle Port Corporations website (<http://www.newportcorp.com.au/site/index.cfm>). This website is updated daily.

For ships that returned surveys the ship movement information recorded on the website was the same as that reported in the respective surveys. Consequently the movement of all ships listed on the website was taken to be accurate for the study.

3.3.3 AMSA AIS data

To verify that the AIS Trial 1 unit was operational during the survey, the AMSA AIS data feed from Newcastle port was made available. This feed comes from an AIS base station located approximately 13 m from the light house upon which the AIS Trial 1 unit was installed.

The data feed was checked periodically to ensure the correct operation of the AIS Trial 1 unit. This included checking both that the unit was transmitting and that it was transmitting at the correct rate.

3.3.4 AIS-B self reporting

A cellular modem was installed with the AIS Trial 1 unit with the intention of making the data feed, both transmitted and received AIS messages, available during the study. The modem was not always operational and limited amounts of data were collected by this method.

4. Study results

4.1 Surveys

Of the 313 individual ships that entered Newcastle Port a total of 169 surveys were received, a return rate of 54%. One survey was provided by a Newcastle Port Pilot.

From 17 September 2008 Vessel Agents were asked to distribute V2 of the survey rather than V1. Unfortunately a seamless transfer from one version to the other was not achieved. V1 was still being distributed by some Vessel Agents until 16 Nov 08.

4.1.1 Results from surveys

Table 2 displays the breakdown of returned surveys by version type (V1 or V2) and how many of these were not completed. Table 2 does not include the one survey provided by the Newcastle Port Pilot that was in neither format. "Completed" here means sufficient

information was provided to be useful for the study. A slightly higher percentage of V2 surveys were completed than V1.

Table 2: Number of surveys collected as well as the number of in-complete surveys, with respect to survey version

Survey version	Number received	Number in-complete
V1	80	7 (8.8%)
V2	88	4 (4.5%)

Figure 4 displays, for each model of AIS-A equipment, the number of surveys received as well as the number completed, with respect to version number of the survey. For V1 of the form five of the seven uncompleted forms occurred when Vessel Masters were using models JHS-180 or FA-100. For V2 of the form no more than one form was uncompleted for any particular model of equipment. See section 4.2.1 for a description of the capabilities of different AIS-A models.

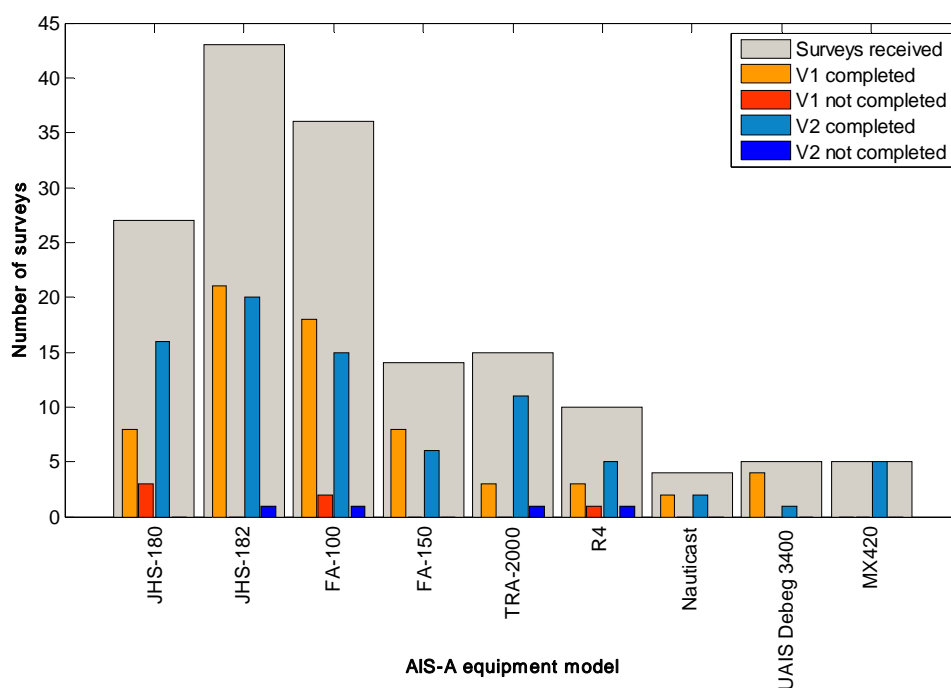


Figure 4: Number of surveys received and number of surveys completed with respect to survey version and AIS-A equipment model

4.2 AIS equipment on-board commercial vessels

4.2.1 AIS-A equipment types and capabilities

As shown in Figure 5, the majority of the AIS-A equipment carried by large commercial vessels entering Newcastle Port is sold by either Japan Radio Company (JRC) or Furuno.

Both of these companies have two models in use in the market. For both companies the older model (JHS-180 and FA-100) is not capable of decoding Message 24, whilst the newer model is capable. Decoding of message 24 is required to obtain the name of the vessel.

Of the AIS-A fitouts surveyed in Newcastle Port 37% did not decode message 24 and consequently did not display the name of the vessel carrying the AIS-B system. These systems displayed the vessel's MMSI instead.

In Figure 5, "Other" covers equipment for which either only one survey was received for a particular model of AIS-A equipment or the section in the survey covering details of the AIS-A equipment was not completed.

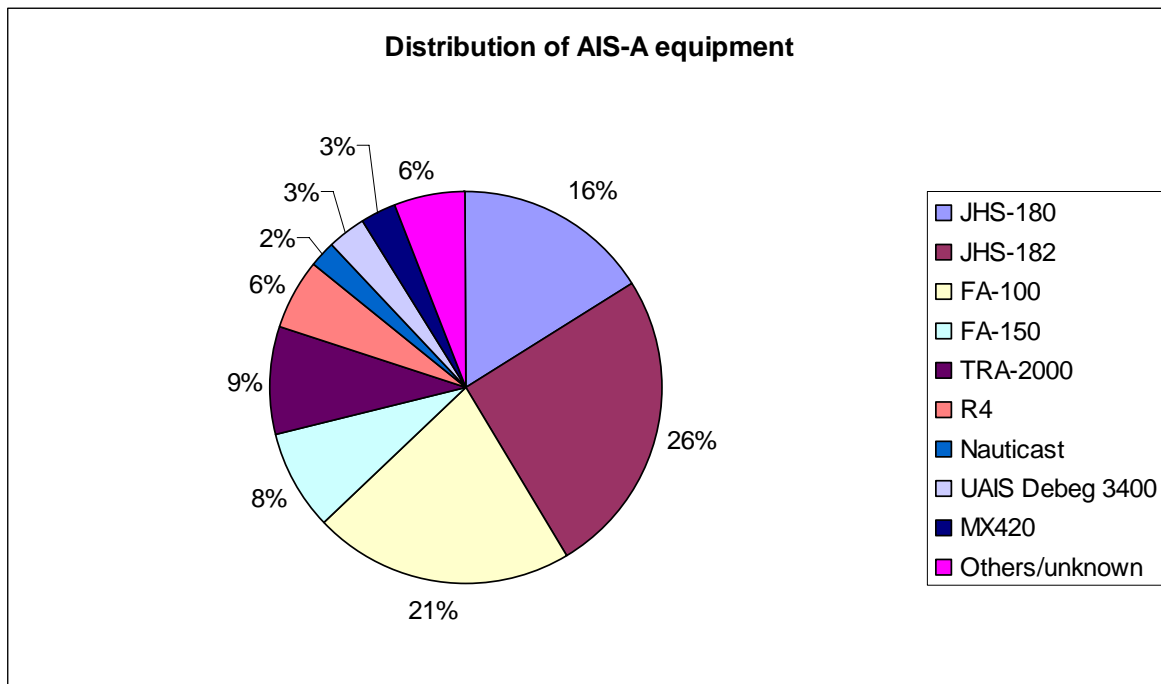


Figure 5: Distribution of AIS-A equipment as reported by vessels

4.2.2 Standards satisfied

The AIS standard has evolved since its inception to include more message types, an additional network access method for AIS-B, and other components not critical to this study such as standards for base-stations, channel management and binary messages. A diagram of standards documents can be found in Appendix F.

The standards reported to be satisfied by the different AIS-A equipment observed in the study is contained in Table 3.

Equipment listed in *italics* were captured under "Other" in Figure 5. For a few pieces of equipment no information could be found on the internet. It should be noted that DSTO did not verify the equipment details provided by Vessel Masters in the completed survey

forms, so it is possible that the manufacturer and model details provided to DSTO may have been incorrect. Note: “Mentioned” means the standard was mentioned in the documentation available to DSTO, but the context could not be determined because the information was not in English. “Former-may-use” is a United States Coast Guard nominated status indicating the “Product is no longer approved for production but previously produced items may continue to be used as long as in good and serviceable condition” [2].

Table 3: AIS-A equipment recorded in the study and their status with respect to the standards. Key: “C” – Complies, “M” – Mentioned; “NM” – Not Mentioned

Manufacturer	Model	IMO MSC 74(69) Annex 3	ITU-R M.1371	DSC ITU-R M.825	IEC 61993-2	IEC 60945	FCC / US Coast guard status (http://cgmix.uscg.mil/Equipment/EquipmentSearch.aspx)
Japan Radio Company	JHS-180 [3]	C	C	NM	C	C	Approved
Japan Radio Company	JHS-182 [4]	C	C	NM	C	C	Approved
Furuno	FA-100 [5]	C	C	C	C	C	Former-may-use
Furuno	FA-150 [6]	C	C	C	C	C	Not listed
Tokimec	TRA-2000 [7]	M	M	NM	M	NM	Not listed
SAAB	R4 [8]	C	C	NM	C	C	Former-may-use
Nauticast	Nauticast [9]	C	C	C	C	C	Approved
SAM electronics	UAIS Debeg 3400 [10]	C	C	C	C	C	Former-may-use
Leica / Tokimec	MX420 [11]	C	NM	NM	NM	NM	Not listed
SeaTex	AIS 100 [12, 13]	C	C	NM	C	C	Former-may-use
Kelvin Hughes	NIS 2002 [14]	C	NM	NM	NM	NM	Not listed
Marine Data Systems	EN60945	No information available					Not listed
Saracom	UAIS SI-10	No information available					Not listed
Tokimec	SAAB transponder	No information available					Not listed

4.3 AIS-B detections

4.3.1 AIS-B detection – all ranges

For the study an “AIS-B detection” was recorded as true if any AIS-B carrying vessel was reported as being detected. During the trial this included the AIS Trial 1 unit and any of the five dredges working in Newcastle River.

Table 4 lists the number of completed surveys versus the number of AIS-B detections at any range with respect to AIS-A equipment model. This table indicates all of the listed

AIS-A equipment, representing 94% of the fitouts observed in the study, are capable of detecting an AIS-B signal.

Of the completed surveys received six listed equipment that was only named once during the trial period. Another three did not list the AIS-A equipment in use. In these cases a conclusion could not be drawn about whether this equipment was able to detect AIS-B signals as the equipment was either unknown or there was only one sample point. Consequently no conclusions will be drawn from these 9 surveys (6%).

Note: - Table 4 does not indicate reliability. The data in Table 4 is for all ranges but the signal from the dredges or AIS Trial 1 unit was only reliable out to 3.5n. miles.

Table 4: Number of surveys with AIS-B detections at any range, with respect to survey form version and AIS-A equipment model

Manufacturer	Model	Number of surveys completed (any range)	Number of surveys with AIS-B detections (any range)
Furuno	FA-100	33	26
Furuno	FA-150	14	11
JRC	JRC-180	24	14
JRC	JRC-182	42	33
Nauticast	Nauticast	4	2
SAAB	R4	8	8
SAM electronics	UAIS Debeg 3400	5	5
Tokimec	TRA-2000	14	11
Tokimec / Leica	MX420	5	5

4.3.2 AIS-B detection – within study range

It was noted that surveys completed when the first AIS Trial 1 unit was in place show a different trend regarding AIS-B detections to the surveys completed when the second system was in place. As the only change to the study was the replacement of the AIS Trial 1 unit it is felt this difference indicates additional unknown installation problems early in the trial. To ensure only reliable data is used, that is not dependant upon the trial system's setup, only the data from the second unit has been classed as reliable.

Consequently the reliable data in Figure 6 covers the 100 completed surveys received during the period 10 September 2008 until 28 November for AIS-A models of equipment for which more than one survey was received when ships were within 3.5 n. miles of the AIS Trial 1 unit.

At a range of 3.5 n. miles from Nobby's Head Lighthouse any ship carrying an AIS receiver would reliably receive the signal from at least one of the dredges or the AIS Trial 1 unit (post 10 Sept 08). Figure 6 displays the number of AIS-B detections at ranges of 3.5 n. miles or less for the same equipment listed in Table 4.

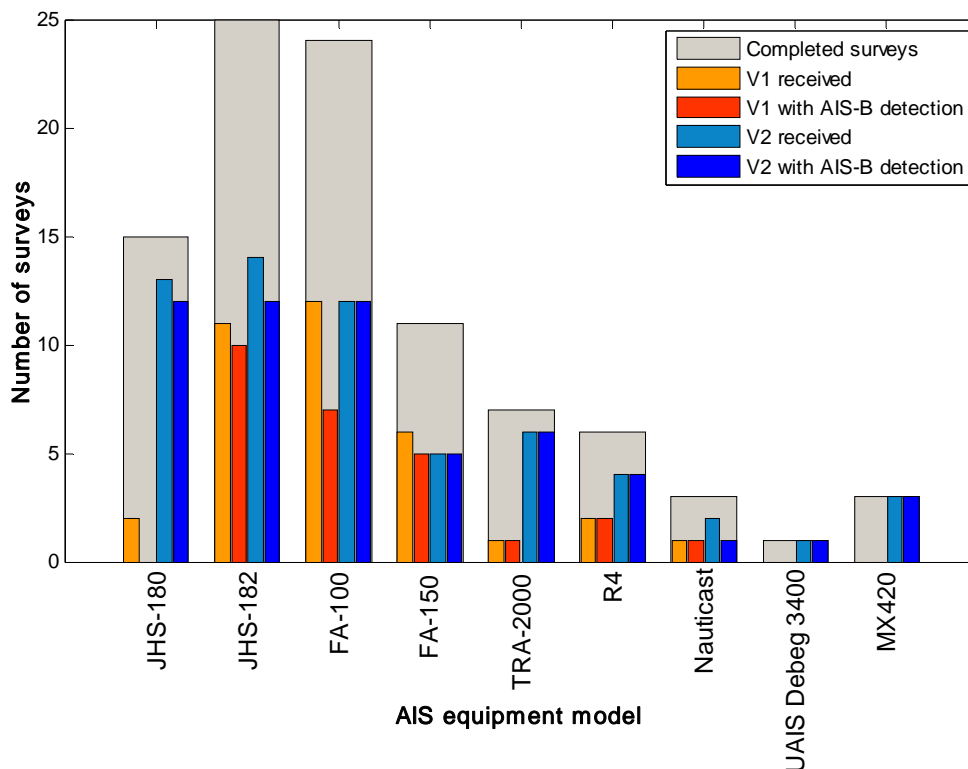


Figure 6: Number of AIS-B detections / non-detections at ranges of 3.5 n. miles or less, with respect to survey version and AIS-A equipment model

Of ships with AIS-A equipment capable of detecting an AIS-B signal 83% reported detecting the AIS-B signal that was in range. Vessel Masters were more likely to recognise an AIS-B detection if their equipment was capable of displaying the vessel's name, as they were provided with the name(s) of the AIS-B trial unit and vessels. Also, Vessel Masters were more likely to report this detection if completing V2 of the form.

4.4 Other interesting findings/observations

4.4.1 Display characteristics of Furuno FA-150

Furuno FA-150 user manual [6] states a vessel either anchored or moored and travelling at less than 3 knots for which a signal has not been received for 10min would be classified as "lost" but still be displayed. If lost for a further 6 minutes and 40 seconds then the vessel information will be removed from the display. Therefore a slow speed anchored or moored vessel carrying AIS-B would be classified as "lost" after 3 missed messages and removed from the display after a further two messages.

4.4.2 Vessel engagement with AIS Trial 1 unit

Whilst inspecting the base station log it was noted a number of vessels sent the AIS Trial 1 unit messages. It can only be assumed the Vessel Master expected someone to reply. We do not know if the ships that did attempt communication were aware of the study at the time.

4.4.3 Performance of single installation of SeaTex AIS 100

The SeaTex AIS 100 equipment was carried by only one vessel. This vessel entered port twice during the study. DSTO happened to visit this vessel during its first visit when the first AIS Trial 1 unit (AIS BX) was in place. During that visit DSTO were able to confirm that no AIS-B vessels appeared on the displays available to the Vessel Master. DSTO was also able to confirm, by placing a portable AIS-A receiver on the deck just outside the bridge of this ship, that AIS-B detections were possible from this berth location.

When this ship returned to Newcastle the new AIS Trial 1 unit (Camino 101) was in place transmitting at 2s interval. On DSTO's request this ship completed another survey. The response was another "No" for AIS-B detection. Kongsberg, the manufacturer of the equipment, was contacted and confirmed there was no manufacturing reason why an AIS-B signal would not be detected by this model of equipment. Also, that this model of equipment was in wide use in other parts of the world. The SeaTex AIS 100 has been given approval by the German Bundesamt für Seeschifffahrt und Hydrographie [15]. Further investigation into why the equipment on this particular ship was unable to detect an AIS-B signal was not possible because it would have involved close inspection of the actual installation.

5. Conclusions

In summary, on the vessels that entered Newcastle Port and completed a survey, at least 94% of the AIS-A fitouts are capable of receiving and decoding AIS-B signals. No conclusion can be drawn on the remaining 6% of units because insufficient information was collected via the surveys.

Of the vessels carrying AIS equipment that the survey has shown is capable of receiving and decoding an AIS-B signal, 17% reported no AIS-B detections. The study results indicate this was more likely to occur when the AIS-A equipment was not capable of displaying the name of the AIS-B vessel and only displayed the vessel MMSI, suggesting, in some of these cases, that the Vessel Master may not have recognised the detection.

Also, a significant lesson learnt was that, even where the vessel names are displayed, it is important to specify particular AIS-B vessels when questioning a Vessel Master about AIS-B detections. This is because AIS-A displays do not distinguish AIS-A detections from AIS-B detections.

6. Acknowledgements

This three month study would not have been possible without the assistance and support from many organisations and people. The authors would like to acknowledge and thank the following organisations and people for their efforts.

2. Newcastle Port Corporation for guidance with the trial setup and information on ship movements.
3. AMS for assistance with the Nobby's Head setup and assistance with AIS-B equipment problems.
4. AMSA for permission to use Nobby's Head Lighthouse and setting up the AIS data feed for DSTO.
5. ACMA for permission to transmit from land.
6. Newcastle Vessel Agents for distributing and collecting in surveys. In particular Inchcape Shipping Services for arranging visits to commercial vessels.
7. Boskalis Dredco JV for information on AIS dredge installation.
8. Tony White, DSTO, for manufacturing and performing the installation at Nobby's Head.

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Appendix A: AIS message reporting intervals

Table A 1: AIS-A message reporting intervals [16]

Platform condition	Nominal reporting interval
Vessel at anchor or moored and not moving faster than 3 knots	3 minutes
Vessel at anchor or moored and moving faster than 3 knots	10 seconds
Vessel with a speed of between 0 – 14 knots	10 seconds
Vessel with a speed of between 0 – 14 knots and changing course	$3\frac{1}{3}$ seconds
Vessel with a speed of between 14 – 23 knots	6 seconds
Vessel with a speed of between 14 – 23 knots and changing course	2 seconds
Vessel with a speed of greater than 23 knots	2 seconds
Vessel with a speed of greater than 23 knots and changing course	2 seconds

Table A 2: Shipborne mobile Carrier Sense AIS-B message 18 reporting intervals [17]

Platform condition	Nominal reporting interval
Vessel not moving faster than 2 knots	3 minutes
Vessel moving faster than 2 knots	30 seconds

Static data messages 24A and 24B are reported every 6 minutes in addition and independent to message 18. Message 24B will be sent within one minute of message 24A [16].

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Appendix B: AIS installations

No details on the AIS-B installations on the other Newcastle dredges was available.

Table B 1: AIS-B installation details on vessels involved in the study

Name of Vessel / Unit	AIS Trial 1 - Old	AIS Trial 1 - New	P.T. Zarka (dredge)	P.T. Kythira (dredge)
MMSI	005030154	005030154	503098000	503229800
AIS B manufacturer	Shine Micro	Amec	Comar	Comar
AIS B model	AIS-BX	Camino 101 ¹	CSB 200	CSB 200
VHF antenna manufacturer	Pacific Aerials	Pacific Aerials	Glomex	Glomex
VHF antenna model	Longreach	Longreach	RAI225	RAI225
VHF antenna length	2.5m	2.5m	2.4m	2.4m
VHF antenna gain	3dB	3dB	6dB	6dB
VHF antenna cable type	LMR-400-DB	LMR-400-DB	RG58	RG58
VHF antenna cable length	25m	25m	unknown	unknown
GPS antenna manufacturer	Rojone	Rojone	Furuno	Furuno
GPS antenna model	MaxiNav Active 5V standard	MaxiNav Active 5V standard	GPA170	GPA170
GPS antenna cable type	LMR-400-DB	LMR-400-DB	RG58	RG58
GPS antenna cable length	25m	25m	–unknown	–unknown
Standard IEC 62287-1 (2006)	Complies	Complies	Complies	Complies
Standard IEC 61162-1 (2000)	Complies	Complies	Complies	Complies
Standard IEC 61162-2 (1998)	Complies	Complies	Complies	Complies

¹ Modified to allow transmit rate to be set by software

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Appendix C: Survey Form 1

Vessel Masters,

Your assistance is required with an important survey being conducted for the Australian Maritime Safety Authority during the period **1 Sept 2008 to 28 Nov 2008**.

All commercial vessels of 300t and over are mandated to carry and use the Automated Identification System (AIS-A). More recently a cut-down version of AIS-A, called "AIS-B", has become available to smaller craft. Both systems use the same VHF bands and should be detected by each other. See "AMSA Automatic Identification System (AIS) Brochure" (email attachment, handout or web site http://www.amsa.gov.au/publications/ais_brochure.pdf). [attachment: AMSA_AIS_brochure.pdf]

The Defence Science and Technology Organisation (DSTO) has been tasked to provide AMSA with the information it needs regarding the impact of AIS-B on the total AIS system for safety purposes. As part of this work a three month study will be carried out in Newcastle. The aim of the study will be to determine the proportion of commercial vessels over 300t that can detect/display an AIS-B signal. The AIS-B signal will be from a fixed land unit located at Newcastle's Nobby's Head Light House.

As the master of a vessel over 300t entering Newcastle Port you are requested to complete the survey below.

IMPORTANT

The survey is to be completed between **1 September 2008 and 28 November 2008** and when within **10nm** of the trial AIS-B unit (**32° 55.1'S 151° 47.9'E**).

Return completed surveys to your Newcastle Vessel Agent.

Final collated results from the survey will be posted on www.amsa.gov.au in early 2009. Individual ship details will not be posted.

All information collected through this survey will be available only to DSTO and AMSA for the investigation of AIS issues.

Your assistance with this study is greatly appreciated.
Sandra Tavener

DSTO Study Lead

Sandra Tavener

Defence Science Technology Organisation
Maritime Operations Division

Study customer

Jillian Carson-Jacksons

MANAGER VESSEL TRACKING
MARITIME STANDARDS DIVISION
Australian Maritime Safety Authority

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DSTO / AMSA survey - AIS-A reception of AIS-B

Return completed forms to your Newcastle Vessel Agent

Electronic fill in - press "Insert" key / Hand fill in - print in CAPITAL LETTERS

Date survey completed (dd/mm/yyyy): _____

Time completed (Australian Eastern Standard Time - hh:mm): _____

Completed by (full name): _____

OWN VESSEL

Position (lat° / long°): _____

Course (°): _____ Speed (knots): _____

Vessel Name: _____

Call sign: _____ MMSI: _____

Type of ship: _____ IMO: _____

Flag of registry: _____

AIS-B CONTACT #1

Named: AIS Trial 1 Contact detected? (YES / NO): _____

MMSI: 005030154

Location: 32° 55.1'S 151° 47.9'E (Newcastle Nobby's Head Light House)

OTHER AIS-B CONTACTS

List other AIS-B contacts detected

1. Name: _____ MMSI: _____

2. Name: _____ MMSI: _____

3. Name: _____ MMSI: _____

4. Name: _____ MMSI: _____

OWN VESSEL AIS EQUIPMENT**Manufacturer:**_____ **Model:**_____**Location on ship:**_____**AIS display type (MKD / ECDIS / Radar (ARPA) / Other):**_____**Manufacturer:**_____ **Model:**_____**AIS-B filter status? (ON / OFF/ Not Applicable):**_____

MKD - Minimum Keyboard Display; ECDIS - Electronic Chart Display System; ARPA - Automatic Radar Plotting Aid

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Appendix D: Survey Form 2

Vessel Masters,

Your assistance is required with an important survey being conducted for the Australian Maritime Safety Authority during the period **1 Sept 2008 to 28 Nov 2008**.

All commercial vessels of 300t and over are mandated to carry and use the Automated Identification System (AIS-A). More recently a cut-down version of AIS-A, called "AIS-B", has become available to smaller craft. Both systems use the same VHF bands and should be detected by each other. See "AMSA Automatic Identification System (AIS) Brochure" (email attachment, handout or web site http://www.amsa.gov.au/publications/ais_brochure.pdf). [attachment: AMSA_AIS_brochure.pdf]

The Defence Science and Technology Organisation (DSTO) has been tasked to provide AMSA with the information it needs regarding the impact of AIS-B on the total AIS system for safety purposes. As part of this work a three month study will be carried out in Newcastle. The aim of the study will be to determine the proportion of commercial vessels over 300t that can detect/display an AIS-B signal. The AIS-B signal will be from a fixed land unit located at Newcastle's Nobby's Head Light House.

As the master of a vessel over 300t entering Newcastle Port you are requested to complete the survey below.

IMPORTANT

The survey is to be completed between **1 September 2008 and 28 November 2008** and when within **3.5nm** of the trial AIS-B unit (**32° 55.1'S 151° 47.9'E**).

Return completed surveys to your Newcastle Vessel Agent.

Final collated results from the survey will be posted on www.amsa.gov.au in early 2009. Individual ship details will not be posted.

All information collected through this survey will be available only to DSTO and AMSA for the investigation of AIS issues.

Your assistance with this study is greatly appreciated.
Sandra Tavener

DSTO Study Lead

Sandra Tavener

Defence Science Technology Organisation
Maritime Operations Division

Study customer

Jillian Carson-Jackons

MANAGER VESSEL TRACKING
MARITIME STANDARDS DIVISION
Australian Maritime Safety Authority

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DSTO / AMSA survey (v2) - AIS-A reception of AIS-B

Return completed forms to your Newcastle Vessel Agent

Electronic fill in - press "Insert" key / Hand fill in - print in CAPITAL LETTERS

Date survey completed (dd/mm/yyyy):_____

Time completed
(Australian Eastern Standard Time - hh:mm)_____

Completed by (full name):_____

OWN VESSEL

Position (lat° / long°):_____

Course (°):_____

Speed (knots):_____

Vessel Name:_____

Call sign:_____

MMSI:_____

IMO:_____

Type of ship:_____

Flag of registry:_____

AIS CONTACTS

<u>Name</u> <u>(YES/NO)</u>	<u>MMSI</u>	<u>Location</u>	<u>Detected?</u>
<i>[AIS Base station]</i>	005030150	32° 55.1'S 151° 47.9'E	_____
AIS Trial 1	005030154	32° 55.1'S 151° 47.9'E	_____
MILCLYN LEGEND	563018000	<i>[moving]</i>	_____
LYDIA	503392000	<i>[moving]</i>	_____
PT ZARKA	503098900	<i>[moving]</i>	_____
BKA RELIANCE	503084000	<i>[moving]</i>	_____

OWN VESSEL AIS EQUIPMENT

Manufacturer: _____

Model: _____

Location on ship: _____

AIS display type

(MKD / ECDIS / Radar (ARPA) / Other): _____

MKD - Minimum Keyboard Display; ECDIS - Electronic Chart Display System; ARPA - Automatic Radar Plotting Aid

Manufacturer: _____

Model: _____

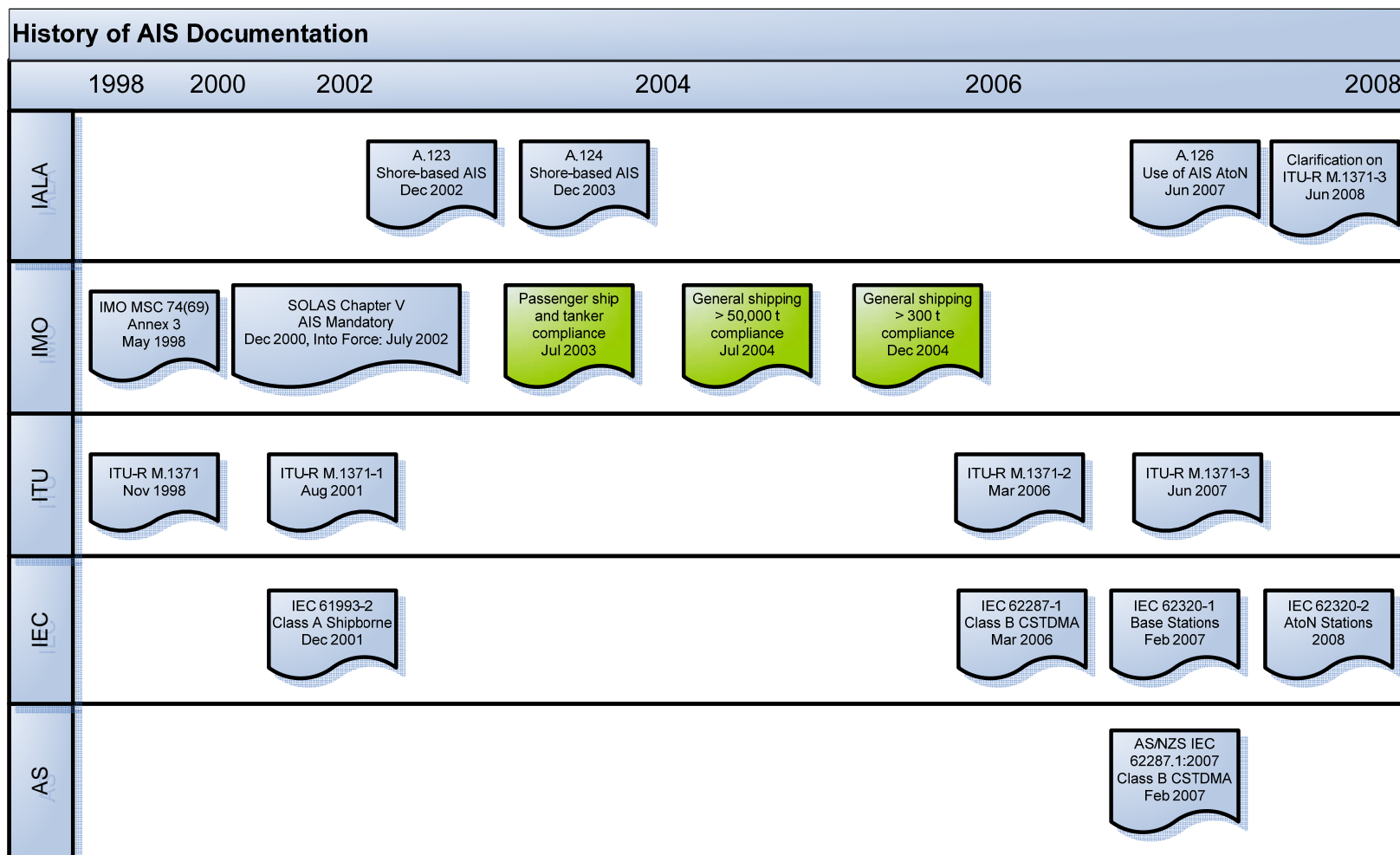
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Appendix E: Newcastle Vessel Agents

- AAL Shipping Agencies Pty Ltd
- Asia World Shipping
- Clark Shipping Pty Ltd
- Gulf Agency Company (Australia) Pty Ltd
- Hetherington Kingsbury
- Inchcape Shipping Services
- McArthur Shipping & Agency
- Monson Agencies
- NYK Lines (Australia) Pty Ltd
- Strang International Pty Ltd
- Wilhelmsen Shipping Services

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Appendix F: AIS Standards Documents



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DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION DOCUMENT CONTROL DATA				1. PRIVACY MARKING/CAVEAT (OF DOCUMENT)					
2. TITLE Automatic Identification System: AIS-A Reception of AIS-B, 2008 Study				3. SECURITY CLASSIFICATION (FOR UNCLASSIFIED REPORTS THAT ARE LIMITED RELEASE USE (L) NEXT TO DOCUMENT CLASSIFICATION) Document (U) Title (U) Abstract (U)					
4. AUTHOR(S) Sandra Tavener and Tristan Cooper				5. CORPORATE AUTHOR DSTO Defence Science and Technology Organisation PO Box 1500 Edinburgh South Australia 5111 Australia					
6a. DSTO NUMBER DSTO-TN-0867		6b. AR NUMBER AR-014-358		6c. TYPE OF REPORT Technical Note		7. DOCUMENT DATE December 2008			
8. FILE NUMBER 490-6-333-1		9. TASK NUMBER JNT 07/222		10. TASK SPONSOR CJOPS		11. NO. OF PAGES 34		12. NO. OF REFERENCES 17	
13. URL on the World Wide Web http://www.dsto.defence.gov.au/corporate/reports/DSTO-TN-0867.pdf					14. RELEASE AUTHORITY Chief, Maritime Operations Division				
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19. ABSTRACT The use of the Automated Identification System (AIS) has been mandated for ships over 300 gross tonne since December 2004. Through Border Protection Command, DSTO was tasked to assist the Australian Maritime Safety Authority with the assessment of the performance of AIS and a new variant AIS-B. AIS-B is a cut down version meant for smaller vessels but there have been concerns by the maritime community that AIS-B cannot be detected sufficiently by vessels carrying AIS. This report covers a three month study investigating this issue. The outcome, based on a survey of vessels entering Newcastle Port, was that the different AIS fitouts carried were capable of detecting AIS-B signals. However, 17% of these vessels did not report detections. This was more likely to occur if the model of AIS equipment only displayed the vessel's identification number because it was not capable of decoding and displaying the name of the AIS-B vessel. This finding indicates the lack of detection issue is to some extent caused by Vessel Masters not recognising the detection on their AIS displays. It was also discovered that even where the name of the AIS-B vessel was displayed, the AIS displays do not distinguish between AIS and AIS-B detections.									